

What is claimed is:

1. A method for forming a composite material, comprising (1) a process for introducing ion exchange groups at the surface of a resin base, (2) a process for introducing metal ions by treating the surface of said resin base with liquid containing metal ions, (3) a process for introducing photocatalyst into the resin base having the introduced metal ions, and/or (4) a process for forming metal on the surface of a resin base by using electromagnetic radiation to irradiate the resin base having said introduced photocatalyst.
2. The method for forming a composite material according to Claim 1, which includes a process in which reducing agent is introduced into the resin base containing introduced photocatalyst after process (3) but before process (4).
3. The method for forming a composite material according to Claim 1 or 2, which includes a treatment process for removing the introduced metal element in regions not irradiated with electromagnetic radiation after process (4).
4. The method for forming a composite material according to any of Claims 1-3, wherein irradiation with electromagnetic radiation is carried out through a master pattern, thus forming a metal pattern.
5. The method for forming a composite material according to Claim 4, wherein the valence of the metal ions introduced into the resin base is two or greater.
6. A composite material having metal on a resin base obtainable by the method of claim 1 or 18, wherein the metal comprises photocatalyst.
7. The composite material of claim 6, wherein the amount of photocatalyst per unit surface area of metal covering the resin base is 10^{-10} to 10^{-3} mg/cm².

8. The composite material of claim 6 or 7, wherein the joining strength between resin base and metal is 5-15 N/cm.

5 9. The composite material of claim 8, wherein the average surface roughness of the resin base at the joining surface with the metal is 1 μm or less.

10 10. The composite material of any one of claims 6 through 9, wherein the metal is a metal selected from V, Cr, Mn, Fe, Co, Ni, Cu, Ga, As, Se, Mo, Ru, Rh, Pd, Ag, Cd, In, Sb, Te, Os, Ir, Pt, Au, Hg, Pb, Bi and alloys thereof.

11. The composite material of any one of claims 6 through 10, wherein the photocatalyst is one or more substances selected from a group comprising TiO_2 , Pt/TiO_2 , SrTiO_3 , $\text{Pt-RuO}_2/\text{TiO}_2$, Pd/TiO_2 , $\text{Fe}_2\text{O}_3/\text{TiO}_2$, NiO-SrTiO_3 , ZnO_2 , ZnS , Pt/ZnS , CdS , GaAs , GaP , $\text{V}_2\text{O}_5/\text{SiO}_2$, Cu^+/SiO_2 , $\text{MoO}_3/\text{SiO}_2$, $\text{CuMoO}_4/\text{SiO}_2$ and Si-W system oxide.

15 12. A composite material obtained by carrying out an additional plating treatment on the composite material according to any of Claims 6-11.

20 13. A method for forming a composite material, comprising
introducing ion exchange groups to a resin base;
introducing metal ions by treating the resin base with liquid containing metal ions;
introducing photocatalyst into the resin base having the introduced metal ions;
and
forming metal on the surface of a resin base by exposing the resin base having the
25 photocatalyst with radiation activating for the photocatalyst.

14. The method of claim 13 wherein the reducing agent is introduced into the resin base containing introduced photocatalyst.

30 15. The method of claim 13 or 14 wherein the introduced metal element in regions not irradiated with electromagnetic radiation is removed thermally.

16. The method of any one of claims 13 through 15 wherein irradiation with electromagnetic radiation is carried out through a master pattern, thereby forming a metal pattern.

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17. The method of claim 16 wherein the valence of the metal ions introduced into the resin base is two or greater.

18. A method for forming a composite material, comprising:

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a) introducing ion exchange groups to a resin layer,

b) treating the resin with metal ions;

c) treating the resin with photocatalyst, and

d) forming metal on the resin.

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19. The method of claim 18 wherein steps a) through d) are conducted sequentially.

20. The method of claim 18 further comprising exposing the resin having photocatalyst with radiation activating for the photocatalyst.

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21. The method of any one of claims 18 through 20 wherein a reducing agent is introduced into the resin containing photocatalyst.

22. The method of any one of claims 18 through 21 wherein metal in resin regions not irradiated with radiation is removed.

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23. The method of any one of claims 18 through 22 wherein the resin is exposed to patterned radiation.

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24. The method of any one of claims 18 through 23 wherein the valence of the metal ions introduced into the resin is two or greater.